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Zero Retries is an independent newsletter about technological innovation in Amateur Radio.

About Zero Retries

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Request To Send

Zero Retries now has 700+ subscribers! As of 2022-01-01, there were 224 subscribers. ***Thanks folks!***

In 2023, I would like to request something of all you co-conspirators for technological innovation in Amateur Radio:

If you see something Zero Retries Interesting going on (that you haven't already read about in Zero Retries or mentioned in the latest Zero Retries Omnibus), *please mention it to me*. Even if it's a "um, what's this?" I'm especially in need of introductions to those involved in the project, preferably via email.

One primary difference about Zero Retries versus other Amateur Radio media is that if I'm told of something interesting going on, I'm willing to investigate further and likely write it up here in Zero Retries. *I'll go after the story* rather than passively "invite submissions". I understand that not everyone is willing or able to write up something for publication… but I've long since "burned out" my inhibitions about writing about things that I don't have any direct experience

with. Not to mention sometimes getting it wrong writing about subjects I do have some experience with.

One primary "editorial" plan for Zero Retries in 2023 is to provide broader perspective on Zero Retries Interesting projects, products, etc. - not just my voice. I will be doing a lot more interviews and including the voices of the interviewees (in text, here in Zero Retries) to explain things better than I can. At a minimum, now that I'm no longer encumbered by "can't talk to the grant recipients" restriction due to my involvement with ARDC, I've got two years of Zero Retries Interesting projects funded by ARDC grants to dig deeper into.

But, I really need help with introductions.

Lastly, please spread the word about Zero Retries to your co-conspirators for technological innovation in Amateur Radio. 700 subscribers is cool… but 1000 would be *very cool*.

de Steve N8GNJ

Packet Radio - *Faster!*

One of the best sources of information for Zero Retries is being subscribed to a number of mailing lists as a Lurker. Such was the case in a recent discussion on the EastNetPacket Group mailing list. Ronny Julian K4RJJ asked…

Why are there no 56K modems/TNCs?

> Any true techy types want to tell me why the technology is stuck at 1200bps when people were doing 56K in 1996? I just read this and with cheap microprocessors that beat out anything we use on 9600bps why are we stuck at these slow speeds?
>
> https://hackaday.com/2020/06/09/an-open-hardware-modem-for-the-modern-era/
>
> I remember a backbone running across the entire east/west area of downtown Atlanta GA with two GRAPES modems and that was ion the 90s.

Unfortunately, the conversation bogged down into a lot of conflation of different things lumped into the discussion. I provided partial replies to the question in the email thread, but here's my take on a more comprehensive answer to the question.

If you want to run faster than conventional 1200 bps / 9600 bps packet radio on Amateur Radio, you can! But, doing so, requires considerably more work and more expense than conventional 1200 bps / 9600 bps packet radio. But mostly, you have to convince others to similarly do that "considerably more work and expense" to have someone to communicate with.

My point here is not so much to advocate specifically for these specific systems, but rather to make a couple of points:

1. There's a lot that can be done using existing, constrained resources such as typical

Amateur Radio units, 20 kHz VHF / UHF channels *if you can apply modern technology*.

2. if you really want to move beyond the low speeds of Amateur Radio packet radio, there *are* choices available but they probably won't be backwards compatible. To use them will be more expensive, a learning curve, and getting others to buy into the same system.

VARA FM - 25 kbps

The best example of "… *you can!*" that fits with the general theme of the question (conventional packet radio, just *faster*) is to use VARA FM. With an off-the-shelf Amateur Radio such as a Yaesu FTM-6000R, an audio interface intended for higher speed software modems such as the Masters Communications DRA-45, and a Windows PC, you can be doing data communications over a typical Amateur Radio VHF / UHF 20 kHz channel at speeds up to 25 kbps.

For a deep dive on why I think that VARA FM is superior to Amateur Radio packet radio, see Zero Retries 0004 and Zero Retries 0006.

At $260 for the radio, and $110 for the interface and ~$70 for the VARA FM license key, a "built for fastest speed" VARA FM system is reasonably affordable for individuals. Alternatively, VARA FM can be used on *any* Amateur Radio unit, and almost any audio interface, to run at lower speeds than 25 kbps (but still faster than conventional Amateur Radio packet radio) and be fully interoperable with "built for fastest speed" VARA FM stations.

Any VARA FM station can act as a digipeater (VARA FM only, not packet radio) and if you have access to a high profile site, you can install a dedicated VARA FM digipeater. VARA FM includes a KISS interface for interfacing with traditional packet radio software - BBS, AX.25 networking, etc. With the KISS interface, traditional packet radio software can interact with a VARA FM system as if it's a KISS TNC.

To those that argue that VARA FM isn't Amateur Radio packet radio… you're correct.

VARA FM works so well - very robust, 25 kbps, accommodates slow and fast VARA FM systems on the same channel, *because it isn't packet radio*. VARA FM uses a "clean sheet of paper" approach - uses Orthogonal Frequency Division Multiplexing (OFDM) modulation, not packet radio's Audio Frequency Shift Keying (AFSK) or Frequency Shift Keying (FSK) or even Gaussian Minimum Shift Keying (GMSK) used on the better 9600 bps units. VARA FM integrates other technologies such as Forward Error Correction (FEC) to provide a very robust data communications system over conventional 20 kHz Amateur Radio channels, using off the shelf Amateur Radio units.

Icom DD Mode - 128 kbps

Digital Data (DD) mode is the "forgotten D-Star mode" first implemented in the Icom ID-1 radio. The ID-1 operated on 1240-1300 MHz and was able to do 128 kbps in a 100 kHz channel. DD mode lives on in the Icom IC-9700 radio and Icom also offers the ID-RP1200VD repeater which is compatible with DD mode.

DD mode is essentially an Ethernet bridge - Ethernet packets into the radio, radio packets out, and vice versa. DD mode is designed to run TCP/IP, but of course Ethernet is "agnostic" as to protocols. (I've always thought it would be interesting to run other network protocols over DD

mode, such as Novell IPX/SPX).

DD mode using IC-9700s and the ID-RP1200VD repeater is expensive, but off-the-shelf and doable.

New Packet Radio - 500 kbps
Where VARA FM takes a clean sheet of paper approach to software modems, New Packet Radio (NPR) is a clean sheet of paper approach to the entire *radio*. NPR can do 500 kbps using a 100 kHz channel. Despite the name, NPR has no backwards compatibility to Amateur Radio packet radio. For one, it uses TCP/IP as its networking protocol. NPR is also pretty affordable of a few hundred dollars per station, and like VARA FM, if you have a suitable location, you can set up an NPR "digipeater" that can help build a network.

Microwave Networking - 1 Mbps+
Amateur Radio has been doing networking via microwave frequencies for decades, but it has accelerated with the advent of inexpensive but capable microwave devices such as those developed for the Wireless Internet Service Provider (WISP) industry. AREDN is replacement firmware for various Wi-Fi and WISP units that lets Amateur Radio operators experiment with mesh networkingSome of those units can be configured for portions of spectrum that are semi-exclusive to Amateur Radio. Many groups choose to use the WISP units as-is, on license-exempt spectrum that anyone can use. Doing so neatly sidesteps issues about encryption not being allowed for Amateur Radio operations.

But, microwave communication requires optical line of sight - if you cannot see the other station optically (such as a telescope) then it's unlikely the microwave link will work. Thus areas with line of sight potential such as those areas with tall mountains or access to a broadcast tower can implement microwave networks.

Amateur Radio 9600 bps Packet Radio
If the above doesn't quite "resonate" with you, and what you're really asking is how to do "classic" packet radio a bit faster than 1200 bps, there are solutions available.

For years, perhaps a decade, the Kenwood TM-D700 and TM-D710 (all now discontinued) radios provided perhaps the best 9600 bps radio + modem available off-the-shelf, because the radio and the modem were designed as an integrated unit. Unfortunately these radios suffered as general purpose data radios; their built-in TNC was limited, especially in passing through larger packets.

The Dire Wolf software Terminal Node Controller (TNC) supports 9600 bps and it can be run quite effectively on host computers as minimal as a Raspberry Pi 3B+. There is a development branch of Dire Wolf that implements IL2P Forward Error Correction (FEC) to make 9600 bps more reliable - see below.

The NinoTNC supports 9600 bps and optionally can use Improved Layer 2 Protocol (IL2P). IL2P is a streamlined protocol originally designed for the NinoTNC and implements integrated Forward Error Correction (FEC). Using IL2P makes 9600 bps far more usable as single bit errors are (usually) automatically compensated for.

Future Data Communications in Amateur Radio

As I frequently discuss here in Zero Retries, in my opinion, data communications in Amateur Radio we has a bright future ahead of it using Software Defined Radio (SDR) technology. To illustrate how much can be done with "just software", remember that telephone modems two decades ago went from being able to do 1200 bps to 33 kbps[1] in a few short years. Same phone line (300 Hz - 3 kHz - a 2700 Hz channel); the better technology in the modems improved from ~2 bits / Hz to ~12 bits / Hz).

Applying that simple example - 12 bits / Hz in a 20 kHz Amateur Radio VHF / UHF channel could (totally theoretically) result in data rates of 240 kbps.

I predict we'll see some interesting new high speed modes in 2023 as we see a confluence of Software Defined Radios such as the RPX-100 and new software modems such as Rattlegram / Ribbit, Mercury, and more communities willing to do experimention on Amateur Radio beyond the same ole, same ole of Amateur Radio packet radio.

…

Apologies for the short shrift on all of the above discussions. At a minimum, all of these options (and more) merit a dedicated page to explain them in depth. I plan to do so in 2023, as well as entire chapters of a forthcoming book.

ZR > BEACON

- ***Next ARDC Community Meeting on Saturday, January 21, 2023***
  The Zoom meeting will take place at 1700 UTC and cover ARDC's 2022 grants, introduce our new advisory committee members, and report on the recent assessment of 44Net usage and technology. For Zoom info, please register.
  It will be interesting to see the results of the "assessment of 44Net usage and technology". Tagging onto that…

- New Volunteers for ARDC Grants Advisory Committee (GAC) and Technical Advisory Committee (TAC). The GAC is now up thirteen (ten in 2022) and TAC is now up to ten (six in 2022). See ARDC's Who We Are page for the updated rosters; I'm sure that eventually the page will accurately reflect the 2022 GAC Alumni. I wish ARDC and especially the GAC and TAC well in 2023 - it will likely be a busy year for ARDC grantmaking and hopefully with the 44Net assessment analyzed, 44Net can make some progress on modernization.
  Update: The 2023-01 ARDC Newsletter (as I write this, not yet on their website, only email) mentions these goals for the TAC in 2023:

  - Review and catalog dominant 44Net use cases
  - Create a uniform policy for 44Net coordination
  - Substantive updates to the Wiki knowledge base
  - Development of a new 44Net Portal

- AOIC - All In One Cable (for a portable radio) - A project in progress to develop a single board that integrates an audio interface, Push To Talk (PTT), and a programming interface that plugs into the “speaker / microphone” jacks on a portable radio.
  The AIOC is a small adapter with a USB-C connector that enumerates itself as a sound-card (e.g. for APRS purposes) and a virtual tty ("COM Port") for programming and asserting the PTT (Push-To-Talk).
  The example shown is a Wouxun unit, but it was also tested on a Baofeng UV-5R.
  Imagine how this progresses in the Hacking community when it’s paired with Rattlegram / Ribbit as modem software.

- Free ebook - *Exploring Software Defined Radio (featuring Raspberry Pi Projects)*
  This eBook discusses wireless applications, with a focus Software Defined Radio, featuring technologies developed for the Raspberry Pi.
  Unfortunately before you can download, you must “register” your email address… TANSTAAFL2.

- Intro to AllStarLink - Tom Salzer KJ7T did a great explanation of AllStarLink in his 2023-01-08 issue of The Random Wire newsletter.
  Intro to AllStarLink
  What it is, how to get started, and how I use it
  AllStarLink is a network of Amateur Radio repeaters, remote base stations and hot spots accessible to each other via Voice over Internet Protocol. AllStarLink runs on a dedicated computer (including the Raspberry Pi) that you host at your home, radio site or computer center.
  Source: https://www.allstarlink.org/
  I recommend subscribing to The Random Wire - KJ7T writes well, often about Zero Retries Interesting subjects, and like Zero Retries, it’s free as in beer to subscribe.

- Why are antennas popping up all over the foothills? Salt Lake City seeks to solve mystery. Not Amateur Radio (that I know of…), but I’ve often fantasized about doing a similar thing. Per the article, this isn’t a viable idea (long term), though my approach would be a bit stealthier. One neat idea I got from PacComm was to build the electronics, battery, etc., everything except a solar panel and the antenna into a PVC pipe and bury that for very minimal exposure and temperature stability. Or, paint it to match a tree trunk and hang it in a tree. Some solar panels are getting pretty good watts / square inch thus they can be pretty small, and electronics are getting steadily more efficient.

- Building Infrastructure in the Rocky Mountains and the San Francisco Bay Area - article by ARDC about some of their grants that helped build out Amateur Radio microwave networks.

- Project OWL announces new release of ClusterDuck Protocol to build emergency mesh networks - From 2021-02-17, but I just discovered it. **IBM?!?!?!**
  The CDP project provides a system to manage an ad-hoc mesh network of Internet of Things (IoT) devices (Ducks) based on LoRa (long range radio) that can be deployed quickly and cheaply. Project OWL invented the technology as part of the inaugural Call for Code Global Challenge in 2018.
  In March 2020, Project OWL launched the open source ClusterDuck Protocol project together with IBM and The Linux Foundation to provide a home for the community and

to expand the ecosystem to additional stakeholders around the world.
Today, we are excited to announce four technology updates for our users, and we invite developers to help us improve the hardware, software, and analytics that drive them, to help provide connectivity wherever it's needed in the wake of disasters.

Updata

- "TW" in the comments for Zero Retries 0080 identified some source code for Rattlegram / Ribbit, at least for the modem code:
    - If you are interested in the modem used for Rattlegram, here you go: https://github.com/aicodix/modem/tree/short
    - We have a Reddit community about the COFDMTV technology used in the modem: https://www.reddit.com/r/COFDMTV/
    - And there is also the COFDMTV website on our homepage: https://www.aicodix.de/cofdmtv/
- Re: My followup on the idea of the Amateur Radio Omnipedia in Zero Retries 0080, the person who provided me with the example of the Packet Radio page on Wikipedia being dumbed down agreed to be named - my friend Larry Gadallah NM7A. NM7A provided this link to his fine work: https://en.wikipedia.org/w/index.php?title=Packet_radio&oldid=484794772
Yeah, we really do need a dedicated Amateur Radio Omnipedia so that work like NM7A's won't get corrupted by nitwit editors.

Feedback Loop

Good comments from Zero Retries 0080:

- **Nate Bargmann** - Thanks for the link to the discussion of 6PACK and FlexNet. I recall reading mentions of them "back in the day" but that thread gave a good explanation of both.
- **Tom Salzer** - Yep, I went to buy a Mobilinkd TNC a few weeks ago and discovered that the TNC3 was sold out and they were going to come out with the TNC4.
- **TW** - This comment seems to break down how the Rattlegram/Ribbit source is organized: https://github.com/aicodix/code/issues/1.

Join the *Fun* on Amateur Radio

If you're not yet licensed as an Amateur Radio Operator, and would like to join the fun by

literally having a license to experiment with radio technology, check out **Join the Fun on Amateur Radio** for some pointers.

Closing the Channel

In its mission to highlight technological innovation in Amateur Radio, promote Amateur Radio to techies as a literal license to experiment with wireless technology, and make Amateur Radio more relevant to society in the 2020s and beyond, Zero Retries is published via email and web, and is available to anyone at no cost. Zero Retries is proud *not to participate* in the Amateur Radio Publishing Industrial Complex, which hides Amateur Radio content behind paywalls.

My ongoing ***Thanks*** to:

- Tina Stroh KD7WSF for, well, *everything!*
- Pseudostaffers Dan Romanchik KB6NU and Jeff Davis KE9V for continuing to spot, and write about "Zero Retries Interesting" items on their blogs that I don't spot on my own.
- Amateur Radio Weekly consistently surfaces "Zero Retries Interesting" stories.
- Andreas Spiess HB9BLA's YouTube Channel - HB9BLA Wireless features Zero Retries Interesting content.
- The Substack email publishing platform makes Zero Retries possible. I recommend it for publishing newsletters.

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More bits from Steve Stroh N8GNJ:

- SuperPacket blog - *Discussing new generations of Amateur Radio Data Communications - beyond Packet Radio (a precursor to Zero Retries)*

- N8GNJ blog - *Amateur Radio Station N8GNJ and the mad science experiments at N8GNJ Labs - Bellingham, Washington, USA*

Thanks for reading!
Steve Stroh N8GNJ / WRPS598 (He / Him / His)
These bits were handcrafted in beautiful Bellingham (The City of Subdued Excitement), Washington, USA.

2023-01-13

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1

“56 kbps” telephone line modems required the use of a T-1 digital phone line at the service provider to achieve that speed; thus that isn’t an “apples to apples” comparison with a radio channel.

2

Though he didn’t originate the term, reading it in Robert Heinlein’s The Moon is a Harsh Mistress was formative for me.